Wool Production in Canada

CANADIAN CO-OPERATIVE WOOL GROWERS LIMITED

CSF•FCM
Canadian Sheep Federation
Fédération Canadienne du Mouton

Contents

Introduction

The sheep and wool industry in Canada began almost as early as agriculture. The first sheep were brought from France in about 1650 to provide food and clothing. Since that time, sheep have followed settlement to all regions of agricultural Canada and have played an important part in the economy of the country.

Canada is well adapted to sheep and wool production, and through the years this production has been profitable. Wool has played an important role in clothing both civilian and military populations, contributing not only to home industries but also to a substantial commercial textile industry.

Over the years, however, wool production has decreased to only a small fraction of what it used to be. Since 1920, annual raw shorn wool production has not met the requirements of Canadian consumption. Peak production occurred in 1945 when almost 7 million kilograms of shorn wool were produced. Wool production then dropped steadily, but it experienced a revival at the end of the century.

The amount of marketed wool has since declined slightly, directly coinciding with the recent reduction in the Canadian sheep flock, which started to take place around the time of BSE and the closure of the United States border. The border is now opening up, but it did have a negative impact on the industry while it was closed. (Table 1)

Table 1. Shorn wool marketed

Year	1996	1997	1998	1999	2000	2001
'000 kg	1,197.3	1,317.4	1,427.5	1,195.3	1,524.0	1,499.7
Year	2002	2003	2004	2005	2006	2007
'000 kg	1,584.9	1,595.8	1,643.6	1,462.0	1,311.7	1,321.4

Source: Statistics Canada, 2009

Wool growth

Wool is a fibre, or modified hair, that grows from the skin of sheep. Because it is formed as a living substance, its growth is regulated by the inherited characteristics of the sheep and by the general condition of the sheep producing it. Therefore, **the amount and quality of wool produced can be changed through management, breeding and feeding practices.**

The individual wool fibre grows from a small depression, known as a follicle, in the skin. Follicles are well supplied with blood vessels, which carry to the fibre the food materials necessary for its growth. Surrounding each wool follicle are two kinds of glands, known as the sweat and sebaceous (wax) glands, which supply protective materials for the fleece. The sweat glands secrete a material, often called sweat salts, which prevents the fibres from being damaged by sunlight. The sebaceous glands secrete wool grease, which forms a protective covering on the fibre and prevents mechanical damage through rubbing.

Management, breeding and feeding key to wool growth

Wool growth is a continuous process and normally the fibre is not shed. However, some of the Down and Longwool breeds tend to shed in the spring. It has been suggested that wool grows more rapidly immediately after shearing than at any other period of growth, but this is not correct. As long as the animal receives an adequate amount of feed under similar conditions the rate of growth will be uniform. However, a sudden change in feed, exposure to sudden storms, or a high fever, may cause a sheep to lose its fleece (see Fig. 1).

The rate of wool growth is directly related to the amount of feed available. Work at Agriculture Canada's Research Station in Lethbridge, AB has indicated that increasing the protein content of the ration from 1% to 10% increases raw wool production by 16%. Work at the University of California showed that sheep on a submaintenance ration produced 1.1 kg of raw wool annually, whereas those on a fattening ration averaged 3.9 kg. Some of the follicles on sheep fed poor rations failed to function, whereas other follicles produced fine fibres, resulting in lower wool production.

Fig. 1. Normally, wool grows at a fairly uniform rate and is not shed. However, poor nutrition, sickness or sudden changes in feed may cause sheep to slip their fleeces and, consequently, reduce the amount of wool for sale.

Wool production benefits from good flock management

By Bob Padula
Wool Quality Consultant, American Sheep Industry Association (ASI)

It is well known that wool traits are highly heritable and genetics plays a large role in the quality of the wool produced. Every grower makes a conscious decision regarding wool quality when they turn in the ram for breeding. Once fertilization takes place, however, the role of genetics is essentially done and environment and management determines how the animal expresses its genetic potential.

Ironically, when producers devote more attention and management to lamb production and increased lamb survival and growth, wool production benefits by the extra attention and producers actually do their wool clip a favour by letting the sheep reach its genetic potential for wool.

Nutrition significantly impacts wool

It is also widely known that nutrition has a large impact on wool production. Wool is the "canary in the coal mine" – for years, researchers have measured, recorded and evaluated wool as a means to assessing animal nutrition and health status. Biologically, the sheep will divert nutrients away from wool production to other requirements in order to survive, reproduce, or provide for their young. This means wool production will be compromised if animals are not fed and managed properly at the various stages of production during the year. Improper feeding shows up first in wool, but it also has detrimental affects on lamb performance during the early part of the lamb's life.

The 2006 National Research Council Nutrient Requirements for Sheep provides detailed information on the nutrient requirements for sheep production, including wool. Nutrient requirements for wool-bearing sheep are not appreciably higher than those of wool-less or hair sheep. Therefore, the small amounts of additional nutrients required for wool production are included in the maintenance requirement. The additional nutritional requirements for the various stages of production are related to the increased requirements for the non-wool components.

The basics of wool production have been known for years and can be found in the wool chapter of the *Sheep Production Handbook* available from the ASI. The follicles that produce the wool fibres are broadly categorized into primary follicles and secondary follicles.

Primary and secondary follicle development

Primary follicles are usually the largest, and generally arranged in rows in the skin in groups of three, known as a trio group. In the fetus, primary follicles are formed first (by 100 days gestation) and all are growing fibre by the time the lamb is born.

The secondary follicles are the most numerous, tend to be smaller and grow finer wool than the primaries. They are formed later on in gestation (day 90 to birth). By birth nearly all the secondary follicles are developed, but many do not mature (produce fibre) until after birth. Most follicles produce a fibre by about one month after birth.

When pregnant ewes are not properly fed and managed during late gestation and lactation, wool growth for the ewe is impaired and reduced. However, this improper feeding can also reduce secondary follicle development in the growing fetus(es) and nursing lamb(s). If the follicles do not mature and develop, they cannot grow wool fibres and this will be detrimental for wool production the entire life time of the young animal. Therefore, managing and feeding ewes for fetal growth and lactation is critically important for producers from both the lamb and wool side of the equation.

Avoid overfeeding to maximize returns

On the other hand, overfeeding is not only uneconomical and costly for the flock, it can also be a negative for wool. Overfed ewes are more prone to ketosis or pregnancy toxemia, birthing problems, lambs that lack vigour and reduced milk production. The end result is lambs that are not as thrifty early on in life during the crucial period of secondary follicle development and maturation. In addition, overfed ewes will have coarser wool, which is lower in value. Overfeeding is economically and biologically damaging.

The bottom line is growers who focus on lamb production by feeding their sheep properly throughout the year are helping their sheep grow the best wool genetically possible.

Characteristics of wool

The use of wool as a textile fibre dates back to 4000 B.C. when it was used as such by the Babylonians. Its unique physical and chemical characteristics have been responsible for its great versatility and high value in the manufacture of clothing. Although many scientists have tried, they have not been able to produce a synthetic fibre with the same specific characteristics as wool.

Fineness of wool

The fineness, or thickness, of the fibre is the most important single characteristic of wool, greatly influencing its economic value. The degree of thickness determines whether the finished fabric will be a fine dress material or a coarse floor covering. In the wool trade, fineness is either judged visually or measured precisely – it is on this basis that the grades of wool are determined. Wool grades according to their origin (English, American, and Canadian) are given in Table 2.

Micron system provides accurate measurement

Increased emphasis on an exact and highly descriptive method of describing wool grade has produced a measuring system in which individual fibres are accurately measured. The unit of measure is the micron, which is one millionth of a metre or 1/25,000 of an inch. Fineness is expressed as the mean fibre diameter.

From a casual observation it would appear the fibres growing on a sheep's skin are relatively uniform in thickness. However, the fibre thickness may vary from 10-70 microns within the same fleece (see Fig. 2). Rambouillet fleeces usually average 20-25 microns in fibre thickness, whereas Lincoln fleeces average 35-40 microns.

Table 2. Wool grades and their characteristics

English (spinning count)	American	Canadian	Average length (cm)	Thickness range (micron)
64s, 70s, up	Fine staple	Range fine	5.0 - 7.5	19.6 - 22.5
64s, 70s, up	Fine clothing		Under 5.0	
58 - 60s	One-half staple	Range half	6.5 - 9.0	22.6 - 25.5
58 - 60s	One-half clothing		Under 6.5	
56s	Three-eighths staple	Range three-eighths to domestic three-eighths	7.5 - 9.0	25.6 - 30.0
56s	Three-eighths clothing		Under 7.5	
46 - 50s	One-quarter staple	Eastern three-eighths to one-quarter staple	7.5 - 10.0	30.1 - 35.1
44s	Low one-quarter staple	Low one-quarter	10.0 - 17.5	35.2 - 37.0
36 - 40s	Coarse	Coarse	10.0 - 17.5	37.1 up

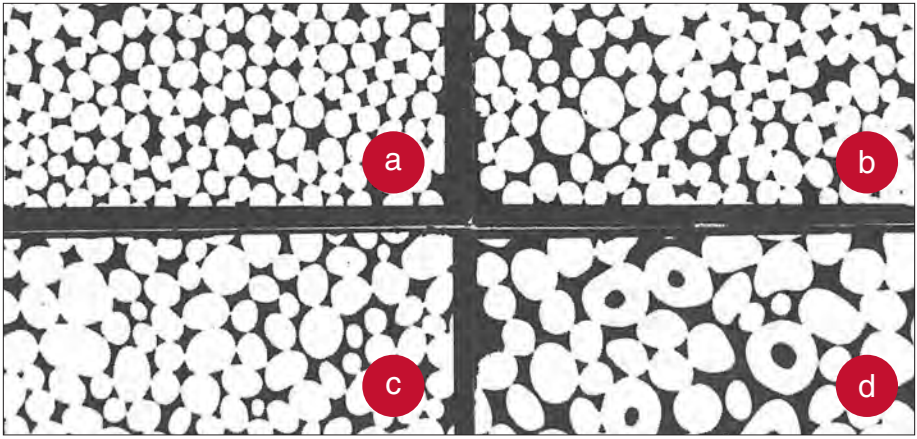


Fig. 2. Cross-sectional views of fibres showing (a) uniform diameter and shape in fine wool, (b) non-uniform fine wool, (c) non-uniform coarse wool, (d) medullation (center of fibre with air spaces).

Length of fibre

Good length of fibre is essential for the production of a superior worsted yarn. Length of fibre is determined to a large extent by the breed of sheep; that is, it is largely an inherited factor, but it can be influenced by nutrition. Experiments have shown that a high plane of nutrition will increase the fibre length by as much as 170% of that produced on a low plane of nutrition. For maximum production the animal must be well fed.

The following minimum, unstretched lengths are required for the various grades of wool before they can be classed as "staple wool."

Fine staple	5.0 cm
One-half staple	6.5 cm
Three-eighths staple	7.5 cm
One-quarter staple	7.5 cm
Low one-quarter staple	10.0 cm

Strength of fibre

To withstand the stress of manufacture and produce a strong, long-wearing fabric, wool must possess tensile strength. To be classed as a "strong wool," a high percentage of fibres must pass through the carding, combing and spinning processes without breaking.

Canadian wool produced under normal range conditions, where the sheep have received sufficient feed, usually has adequate strength. However, there are two conditions that may cause a lack of strength. One condition is known as “tender wool,” i.e., fibre that is weak throughout its entire length. This is usually due to the sheep having some chronic disorder, being on a low plane of nutrition for an extended period, or being old. The second condition is a break, or definite weak spot, at a particular location on the fibre. This is noted readily when the wool is stretched, as it breaks squarely across the staple. Sudden illness, starvation during a bad storm, or overfeeding of concentrates, are mainly responsible for this condition. There can also be some difficulty experienced with a fleece break at lambing time. For this reason, it has become common practice to shear as soon as possible before or after lambing so that shearing will occur at the break; thus the effect of the break will not be apparent in the fleece.

Crimp

Crimp is the term used to designate the natural waviness of wool fibres. The number of crimps will vary from 1 to 30/2.5 cm, depending on the degree of coarseness. More crimps are present in the finer wools. Well-crimped wool will spin more easily and produce a finer and stronger yarn with less wastage than a poorly crimped wool. Uniformity of crimp is associated with uniformity of fineness and length, and is a sign of superior quality.

Colour

The normal colour of wool from the improved breeds of sheep is white, but a small percentage of it may be brown, black, or grey. Generally, manufacturers demand that the wools used in processing be scoured out completely white to ensure that the future colour of the fabric will not be affected by the natural colour of the fibres. **The presence of dark or off-colour fibres in white fabrics causes them to dye unevenly and, in addition, makes them unsuitable for pastel colouring.**

The black-faced breeds, for example Suffolk and Hampshire, tend to have black or brown fibres mixed with the white portion of the fleece on their legs and head, and occasionally throughout the main portion of the fleece.

Felting properties

The capacity to felt, one of the characteristics peculiar to wool and only a few other hair fibres, is attributed primarily to the presence of scales on the surface of the fibre and to its crimpy nature. Under the influence of heat, moisture, alkali

and pressure, the fibres form a wool pad, or cloth, that can be used for wearing apparel. Common items illustrating this type of manufacture are felt hats, felt boots, felt socks and felt cloth. Woven goods may also be subjected to manipulation and pressure in hot, soapy water to produce a felt surface. This process of finishing cloth, known as felting, is commonly employed in the manufacture of melton and billiard cloth.

Elasticity

Elasticity is the ability of wool to return to its original form after having been forced out of shape by pressure. This is one of the peculiar characteristics of wool that makes it superior to other textile fibres. Yarn from highly elastic wool can withstand the stress of manufacture more readily, and the garments produced will hold their shape better than those produced from wool lacking this property. In general, fine wools are more elastic than coarse wools.

Yield and shrinkage

Yield is the amount of clean wool that remains after scouring, expressed as a percentage of the original grease weight. For example, a 4.50-kg grease weight fleece producing 2.25 kg of clean wool has a yield of 50%. In other words, yield represents that portion of the raw fleece available for manufacturing purposes. Shrinkage is the weight that wool loses when scoured, expressed as a percentage of the original grease weight. Shrinkage results mainly from the removal of dirt, manure, seeds, burrs, chaff, straw, sweat salts and wool grease. Because wool processors are interested only in the quantity of clean wool present in the clips they buy, they are able to pay proportionately more for the lighter-shrinking wools.

Information available from testing wool

Commercial lots:

- Average fibre diameter (micron and grade)
- Standard deviation of fibre diameter
- Coefficient of variation
- Percent clean yield
- Vegetable matter present (grease basis)
- Histogram of fibre diameter distribution
- Length and strength (position of break)

Individual animal tests:

- Average fibre diameter (micron and grade)
- Standard deviation of fibre diameter
- Coefficient of variation
- Percent clean yield
- Histogram of fibre diameter distribution

Samples may be taken from individual animals to run objective measurements. Fig. 3 shows the correct area to take sample. Each sample should be 2" square in area to provide adequate test material.

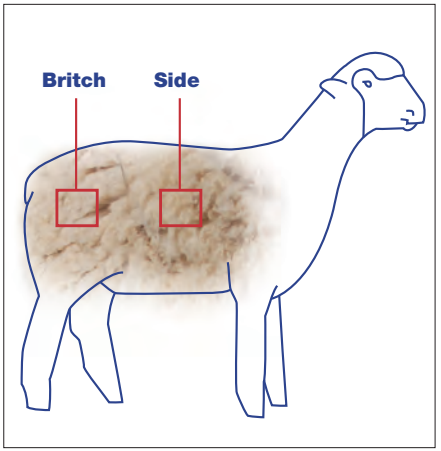
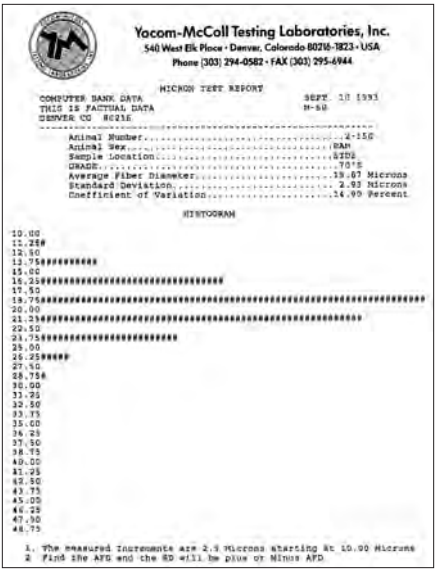


Fig. 3. Side and britch sample sites



Yocom-McColl Testing Laboratories, Inc.
540 West Elk Place • Denver, Colorado 80216-1823 • USA
Phone (303) 294-0582 • FAX (303) 295-6944

MICRON TEST REPORT

COMPUTER BANK DATA — SEPT. 10 1993
THIS IS FACTUAL DATA — M-50
DENVER CO 80216

Animal Number	X-150
Animal Sex	RAM
Sample Location	SIDE
GRADE	70'S
Average Fiber Diameter	19.07 Microns
Standard Deviation	2.93 Microns
Coefficient of Variation	14.99 Percent

HISTOGRAM

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10.00
11.25#
12.50
13.75#########
15.00
16.25#################################
17.50
18.75##################################################################
20.00
21.25#########################################################
22.50
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31.25
32.50
33.75
35.00
36.25
37.50
38.75
40.00
41.25
42.50
43.75
45.00
46.25
47.50
48.75
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1. The measured increments are 2.5 Microns starting at 10.00 Microns
2. Find the AFD and the SD will be plus or Minus AFD

Fig. 4. Individual animal micron test report

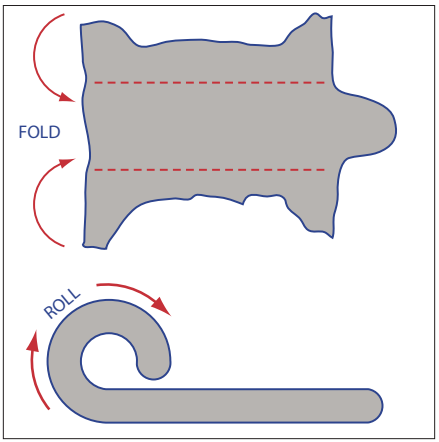
Harvesting the wool

Code of practice for wool preparation

To enable Canadian wool growers to achieve better wool preparation and higher financial returns the following are the recommended guidelines:

1. All sheep need to be emptied out before shearing. I.e., no feed or water to be administered to the sheep for a minimum of 12 hours prior to shearing. By carrying out this practice, the sheep's stomach and bladder will be empty and therefore the wool does not become contaminated with dung and urine. The sheep will also sit better for shearing as they do not struggle the same, which enables the shearing process to be easier for both the shearer and the sheep. Never shear wet wool or pack wet wool.
2. The belly wool needs to be kept completely separate from the fleece wool. The shearer should remove and throw the belly aside as the sheep is being shorn. Belly wool is to be packed separately.
3. All short, stained wool and tags need to be removed from the crutch area as the sheep is being shorn. This wool is kept completely separate from all other types of wool and packed separately.

4. All fleeces should be thrown onto a wool table to enable the skirting of the fleeces to be performed in a proficient manner. Chaffy or bury wool should be skirted from the fleece and packed separately.
5. The shearing board should be swept and kept clean between sheep as well as during the shearing of the sheep.
6. All fleeces should be shaken to remove any second cuts before rolling and pressing the fleeces.
7. When pressing the wool, all the different categories of wool are to be pressed separately. There should be no mixing of the different wool types during shearing, but when pressing at the end of shearing the different types of wool can be put into one bag. However, they need to be separated by sheets of newspaper.
8. All bags are to be sewn with cotton twine. Please do not use baling twine, wire, electric fence wire or polyprop twine to sew the wool bags.
9. All bags need to be identified as to their contents.
10. Where possible during shearing, the level of straw needs to be kept to a minimum and away from the shearing area to minimize contamination.
11. Coloured sheep are to be separated and shorn last so as not to contaminate the white wool with coloured fibres.
12. Fleece preparation incentives of up to 5¢/lb is applicable for bright, high-yielding fleeces that have been properly skirted and packaged (see Fig. 5).
13. Maintaining a clean shearing board and floor is an important and continuous process. It must be done before, during and after shearing to ensure a quality clip.



- Spread skirted fleece on skirting table or clean wool handling area, flesh side down.
- Fold fleece into thirds.
- Roll fleece from rear of animal to front.
- Roll fleece flesh side out.

Fig. 5. Rolling the fleece (all wools)

Time of shearing

Years ago, most sheep in Western Canada were kept on the open ranges almost year-round, and it was the practice to shear them once a year. Shearing time was before the arrival of warm weather and after the danger of late spring storms to avoid the risk of heavy death losses. Nowadays, **most sheep in Canada are located on farms where adequate shelter and housing are available, and shearing can be done any time.** However, sheep with long fleece tend to become itchy in warm weather and this causes them to rub. If they roll on their backs and are unable to get up, death may result. Thus, the most suitable time for shearing is fall, winter or spring. The most critical factors in determining the time of shearing are the availability of shearers and the time of lambing.

Crutching

Sheep are crutched before lambing, if they are to be sheared after lambing. However, if the sheep are sheared about 4-6 weeks before lambing, the need for crutching is eliminated. Crutching involves the removal of wool from the udder, the belly area immediately in front of the udder, and between the hind legs up to the tail.

Crutching or shearing before lambing has advantages:

- Reduced danger of infection of the ewe at lambing. If difficulty occurs during lambing, assistance may be rendered much more easily.
- Reduced losses caused by bacterial infection of the digestive tract in newborn lambs sucking on sweat locks or dung tags, instead of on the teats.
- Minimized lamb losses from wool balls causing blockage in the digestive tract.
- Reduced eye soreness in nursing lambs.

Fundamentals of good shearing

Sheep producers with large flocks usually hire experienced professional sheep shearers. However, in small flocks, shearing is often done by the owner or by a neighbour who has acquired a certain amount of skill through practice. Skilled operators are essential because good shearing requires that a sheep be handled carefully and not be injured while the wool is being removed. If the shearer is experienced, the sheep will not struggle while being shorn. An unskilled shearer will have considerable difficulty in preventing the animal from struggling.

Tips for working with a custom shearer:

- Book well in advance
- Have sheep crutched beforehand
- Pen sheep close 12 hours prior to shearing with no feed or water

- Prepare a clean, well-lighted area with access to an electrical outlet
- Provide plenty of head room
- Have catch pen near the shearing area
- Have extra help for filling the catch pen and preparing the fleece for market

Tips for novice shearers:

- Get qualified instruction
- Shear only dry sheep on a clean, dry surface
- Shear belly wool first and pack separately
- Shear coloured sheep last and pack this wool separately
- Do not shear black face or leg fibres
- Avoid second cuts on the wool wherever possible

There should be no second cuts or short pieces of wool produced by cutting the staple twice. Second cuts reduce the length of fibre and, consequently, its economic value. Also, it is desirable that the fleece be removed in one piece so that it can be properly folded and rolled for market.

Great care must be exercised in shearing the udders, particularly of yearling ewes; it is very easy to cut off the end of a teat and permanently damage that portion of the udder. If a sheep is seriously cut with the shears, the wound should be treated with a disinfectant and, if necessary, sewn.

Methods of shearing

Several decades ago, hand shearing was the only method available to the producer. Power shearing is today's method. It is faster than hand shearing and is easier on the sheep because it is handled for a shorter time. With trained shearers using power shears, the wool is removed with a minimum number of second cuts, thus increasing the value of the wool clips. The danger of injury caused by power shears is no greater than that caused by hand shears; sheep may be cut seriously by either method if the operators are inexperienced or careless.

Researching new techniques

For the past several years, research has been continuing around the world to develop a method of shearing by injecting chemical compounds into the sheep. The chemical compounds would cause, first of all, breaks in the fibre and then, a few days later, the whole fleece to peel off. Such a technique might he useful to small flock operators because they would not then have to either shear the sheep themselves or hire professional shearers. However, this method could create health and reproductive problems to the animals and make the carcasses

unsafe for human consumption. Also, as shown in experiments, some chemicals do not form the breaks uniformly over the whole body within a period of time, thus causing an easy removal at some locations and difficult or no removal at other locations. It is hoped that a reliable and safe technique will soon be developed.

Shearing sheds

Where large flocks are kept, it is often desirable to have a separate, permanent shearing shed. However, any building that has a waterproof roof can he used. The lambing shed is usually the most suitable building available for shearing and is one that can be converted readily for this purpose. **Provision should be made within the shed for large pens to hold the sheep before shearing, a catch pen for each shearer, a smooth board shearing floor, and space for sacking and storing wool.** Slatted floors are desirable in the holding pens to keep the wool as clean as possible. Through the use of these slatted floors, the sheep are raised off the ground and, as a result, have no opportunity of coming in contact with litter or manure.

Preparation for sheep shearing

- Aim for a stress-free shearing day
- Be prepared
- Have an efficient set-up

Shearing facility goals:

1. Delivery of sheep to shearer with minimal effort for handler, sheep and shearer
2. Removal and preparation of wool with minimal effort – clean and careful fleece preparation
3. Skirting table and wool packer conveniently located

Shearing facility tips:

- A dry place – pens, shear floor, wool handling and storage area, all free of drips, leaks, excessive dampness
- Facilities do not need to be permanent – but arrange before shearer arrives
- Get ready the day before shearing
    - Put up temporary lighting in the shearing and wool handling areas
    - Shearing floor should be level to stand on
    - Provide for ventilation
    - Have good wiring to clipper outlet

- Sheep will be reluctant to move toward noise of shearing machine
  - In chute, use a stanchioned "decoy" sheep
  - If possible, have helper for moving sheep so shearer and wool handler can work without interruption
- Catch pens should hold 12-20 ewes (15 ideal)

Examples of layouts for shearing facilities

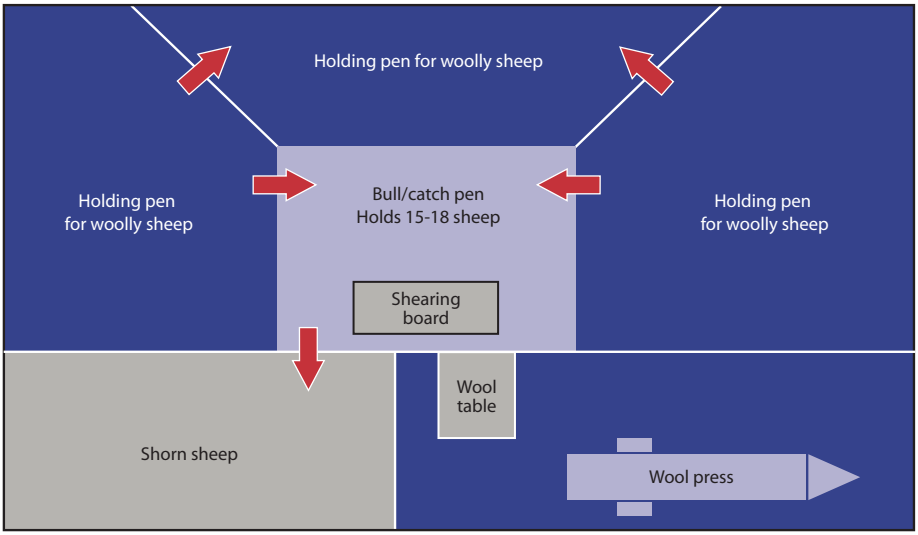


Fig. 6. Shearing board in "bull pen." Sheep are close to shearer for quick catching.

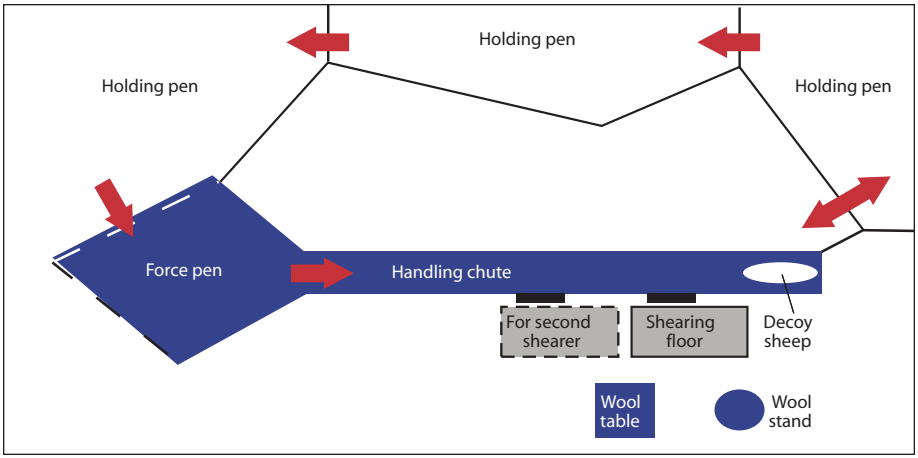


Fig. 7. Portable shearing chute – useful in larger (> 50 sheep) flocks. It is best to have a helper to keep chute full of unshorn sheep.

Preparation of wool for market

It must be kept in mind that the manufacturer makes use of the wool only, and not of the foreign material present in the fleece.

The manufacturer buys fleece wool on the basis of its clean wool content and with the exception of lanolin, everything else is waste material. Consequently, it is in the interest of the wool producer to keep waste material to a minimum by all possible, practical means. Careful preparation of the fleeces will result in higher returns from the wool.

Skirting

The ideal procedure is as follows: Spread the fleece skin side down on a slatted or wire-topped table (see Fig. 8 and 9). Remove all manure tags and stained pieces and pack them separately. Never roll damp tags inside the fleece because they cause discoloration of any wool with which they come in contact. Separate the face and leg pieces from the fleece. Much more emphasis is required on the removal of these parts of the fleece when sheep have not been crutched. In the black-faced breeds, the face and leg areas usually contain black or grey fibres that are particularly objectionable to the manufacturer because they cannot be used in white or pastel-coloured goods. Burry, chaffy or straw portions should also be removed and packed separately.

Fig. 8.

Fig. 9.

Fig. 10.

Fig. 11.

Fig. 12.

Fig. 13.

Fig. 10-13. Preparing the wool for market. After the fleece has been spread skin side down on a slatted or wire-topped table and the low-grade wool removed, one side of the fleece is folded in one-third of the way, then the other side is folded in to cover the first fold. The fleece is then rolled tightly from breech to shoulder.

Folding and rolling

When the low-grade wool has been removed, the most valuable portion is now ready to be folded and rolled. Fold in one side of the fleece one-third of the way and then fold in the other side to cover the first fold. Roll the fleece tightly from breech to shoulder to expose the best portion for inspection when graded (See Fig. 10-13).

Packaging

Black or brown fleeces should be kept separate, as should the tags and skirtings from such fleeces. When the fleeces have been folded and rolled, they are ready for packing in large jute wool bags to permit the wool to breathe. A handful of wool tied in each bottom corner will facilitate handling of the bags when they are filled. Mount each bag on a sacking stand, with the upper end supported by a ring that holds it open (See Fig. 14). **Place the fleeces in the bag and tramp them in firmly. Tight packing permits maximum loading of shipping containers and facilitates handling.** When the bag is full, release it from the ring and sew it with bag needle and cotton twine. One bag will hold approximately 30 fleeces and when filled will weigh between 110-160 kg. Storing the packed wool is an important consideration if it is not shipped to market immediately. Although wool can be held in storage for relatively long periods of time (if kept dry and protected from insects), it tends to deteriorate or lose its life after about two years of storage.

Fig. 14. For filling, the wool bag should be suspended on a sacking frame and the fleeces tramped in as tightly as possible. This permits maximum loading of shipping containers. Note the "ears" at the corners of each bag to facilitate handling.

Another wool packaging option available to producers is high-density polyethylene square packs. The Canadian Co-operative Wool Growers Limited (CCWG) has a lot of information available on wool preparation and building plans for equipment on their website www.wool.ca.

Fig. 15. Horizontal wool press

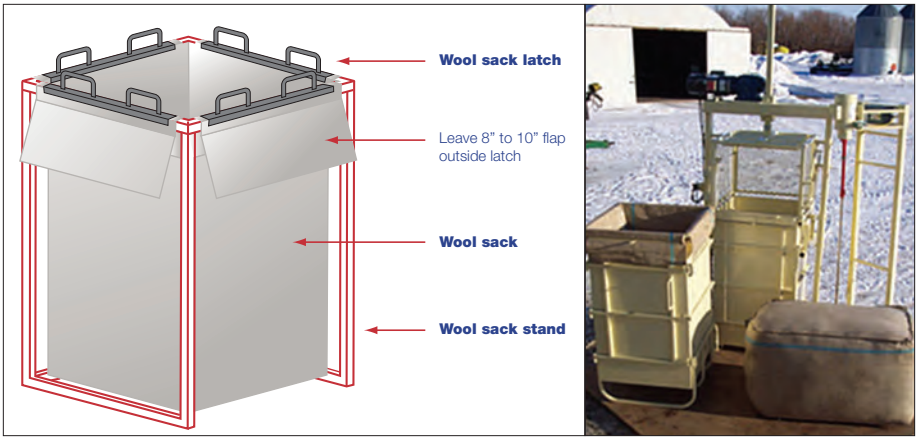


Fig. 16. Electric wool baler

Wool branding of sheep

Where branding is necessary, the sheep should be moved to holding pens as soon as they are shorn and marked with the owner's brand for identification. It is essential the sheep be branded with a material that will not only keep the brand clearly legible for at least one year, but will also scour out in the processing of the wool by the manufacturers. Considerable damage to both machinery and materials can result from the use of an insoluble paint. Such damage increases the cost of manufacture and reduces the price paid by the manufacturer for wool.

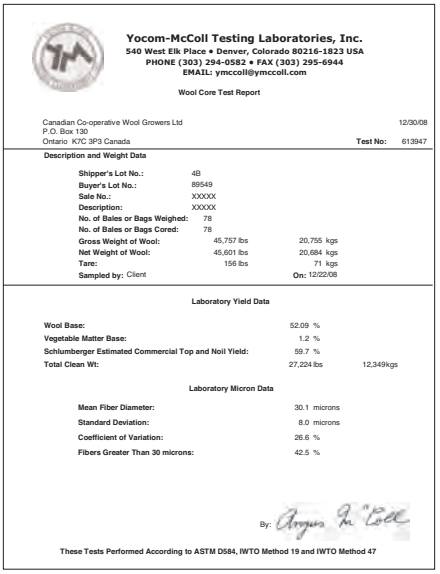
Use soluble branding fluids

Only soluble branding fluids, which are available at all wool growers' supply houses, should be used for branding. A minimum number of brands should be placed on the sheep and the fluid used as sparingly as possible. Materials such as tar, lead paint and crankcase oil should never be used.

Many ranchers prefer to spray for ked control while the ewes are still in the corrals. However, if this is done too soon after branding, blurring will occur and the flock may have to be rebranded. The best procedure, weather permitting, is to spray first and then, after the ewes are dry, to brand.

The marketing of wool

Wool is graded to assist in determining its value and use, and to facilitate its sale. All wool marketed by CCWG is core tested and objectively measured for yield and micron after grading, and packaged into 500 kg bales (see Fig.18).



Yocom-McColl Testing Laboratories, Inc.
540 West Elk Place • Denver, Colorado 80216-1823 USA
PHONE (303) 294-0582 • FAX (303) 295-6944
EMAIL: ymccoll@ymccoll.com

Wool Core Test Report

Canadian Co-operative Wool Growers Ltd
P.O. Box 130
Ontario K7C 3P3 Canada

12/30/08
Test No: 613947

Description and Weight Data

Shipper's Lot No.:	4B		
Buyer's Lot No.:	89549		
Sale No.:	XXXXX		
Description:	XXXXX		
No. of Bales or Bags Weighed:	78		
No. of Bales or Bags Cored:	78		
Gross Weight of Wool:	45,757 lbs	20,755 kgs	
Net Weight of Wool:	45,601 lbs	20,684 kgs	
Tare:	156 lbs	71 kgs	
Sampled by: Client		On: 12/22/08	

Laboratory Yield Data

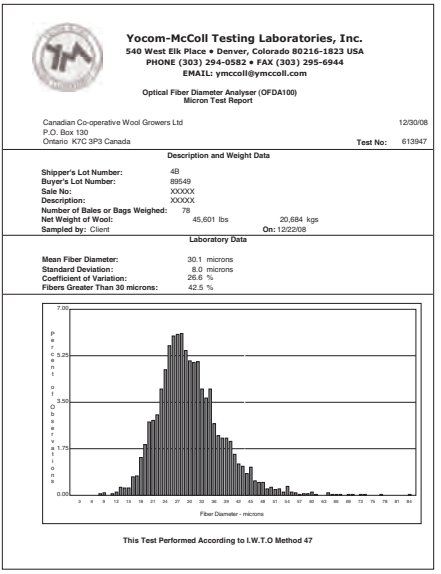
Wool Base:	52.09 %	
Vegetable Matter Base:	1.2 %	
Schlumberger Estimated Commercial Top and Noil Yield:	59.7 %	
Total Clean Wt:	27,224 lbs	12,349kgs

Laboratory Micron Data

Mean Fiber Diameter:	30.1 microns
Standard Deviation:	8.0 microns
Coefficient of Variation:	26.6 %
Fibers Greater Than 30 microns:	42.5 %

By:

These Tests Performed According to ASTM D584, IWTO Method 19 and IWTO Method 47



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Optical Fiber Diameter Analyser (OFDA100)
Micron Test Report

Canadian Co-operative Wool Growers Ltd
P.O. Box 130
Ontario K7C 3P3 Canada

12/30/08
Test No: 613947

Description and Weight Data

Shipper's Lot Number:	4B		
Buyer's Lot Number:	89549		
Sale No:	XXXXX		
Description:	XXXXX		
Number of Bales or Bags Weighed:	78		
Net Weight of Wool:	45,601 lbs	20,684 kgs	
Sampled by: Client		On: 12/22/08	

Laboratory Data

Mean Fiber Diameter:	30.1 microns
Standard Deviation:	8.0 microns
Coefficient of Variation:	26.6 %
Fibers Greater Than 30 microns:	42.5 %

This Test Performed According to I.W.T.O Method 47

Fig. 17. Commercial micron test with histogram and yield report

Markets for Canadian wool

The main market for Canadian wool continues to be China, which is the destination for a significant percentage of global wool production. Canadian wool has been marketed to China for a number of years and is well established there. **China accounts for upwards of 70% of Canadian wool production and the balance is marketed to the United States, India, Western Europe and domestic mills.**

Fig. 18. Graded wool bales at CCWG warehouse in Carleton Place, ON.

Grading of wool

In the wool trade, the fibre thickness determines the grades (see Table 2). Fineness, the most important characteristic, is determined either visually or by exact measurement. The degree of fineness is expressed in grades, which also can be in correspondence with the spinning count, and thickness expressed in microns. The spinning count indicates the number of hanks of yarn obtained from 450 g of clean wool. A hank of yarn is 512 m long. The higher the spinning count, the finer the wool fibres, and the longer the yarn from 450 g of wool. Wool with a spinning count of 64s would yield 64 x 512 = 32,768 m of single-ply yarn.

The grower's price per kilogram of fleece is determined on the basis of the various grades and yield classifications. An example of the form for a Wool Grading Statement is shown in Fig. 20.

Table 3. Micron chart: specifications for grades of wool

Grade	Range for average fibre diameter (microns)	Standard deviation microns maximum
Finer than 80s	Under 17.70	3.59
80s	17.70 - 19.14	4.09
70s	19.15 - 20.59	4.59
64s	20.60 - 22.04	5.19
62s	22.05 - 23.49	5.89
60s	23.50 - 24.94	6.49
58s	24.95 - 26.39	7.09
56s	26.40 - 27.84	7.59
54s	27.85 - 29.29	8.19
50s	29.30 - 30.99	8.69
48s	31.00 - 32.69	9.09
46s	32.70 - 34.39	9.59
44s	34.40 - 36.19	10.09
40s	36.20 - 38.09	10.69
36s	38.10 - 40.20	11.19
Coarser than 36s	Over 40.20	–

Sale of wool

Before 1914, wool was marketed in Canada in a haphazard manner. Most wool was handled by dealers, junk merchants, traders and even butchers who acted as intermediaries between the growers and the manufacturers. The growers had practically no knowledge of the value of their wool and, consequently, had little or no alternative but to accept the price offered.

Co-operative marketing

As a result of recommendations made by a special commission appointed by the Canada Department of Agriculture to investigate the sheep and wool industry in Canada, Great Britain and the United States, grading of wool was begun by the Livestock Branch in 1913. The Commission also recommended that Canadian wool be marketed on co-operative lines. In 1914, wool growers began to organize associations for the co-operative marketing of wool and by 1916, 26 associations were handling the growers' wool.

Fig. 19. Canadian Co-operative Wool Growers Limited, Carleton Place, ON

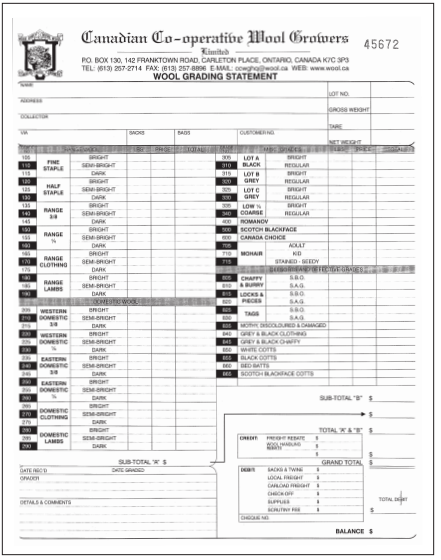

Fig. 20. Blank form for wool grading statement. Each fleece of the producer is graded and the total weight of wool of each particular grade is entered on the form and full payment for the producer's clip is determined.

Selling on a graded basis

However, this method of marketing was still handicapped by many factors. **In 1918, as a result of a meeting of leading sheep breeders and wool growers from every association, the CCWG was incorporated. The primary purpose in organizing this agency was to promote the well-being of the Canadian sheep industry by selling wool on a graded basis in order to obtain the highest market value and by improving the product through proper care and preparation.** As a result of its activities, this organization has had a marked stabilizing effect on wool marketing in Canada. For more information on CCWG, visit www.wool.ca.

Selection for increased wool production

Wool is important as a protective covering for the sheep during the winter months and also accounts for a portion of the revenue from the sheep enterprise. Therefore, it deserves consideration in a sound breeding program. Certain characteristics of the wool fibre are related directly to the amount and

value of wool; thus it is relatively easy to select for high wool production, particularly when replacing breeding stock. **The characteristics to observe, in descending order of importance, are fleece weight, fineness, length of staple and density of fibres on the skin.**

Fleece weight

Raw fleece weight is a good index of total wool production, since it measures the combined effects of fineness, length and density. As a result, satisfactory improvement can be made by selecting on this basis. The most accurate culling can be done at shearing time by actually weighing the fleeces and marking the low-producing ewes for shipment. If this is not practical, an alternative method is to cull by handling the ewes through a chute and picking out the ewes with short-stapled open fleece, hairy breeches, and those that are off-type and of poor quality, Also ewes with too much face cover should be culled to eliminate wool blindness because this condition markedly affects lamb production.

Fineness of fibre

Fineness of fibre determines the grade of wool produced and thus the price received by the grower. Normally finer type wools bring a higher price than the coarser types, although in rare instances this may not be true because of an abnormal demand. It is important that growers select a breed of sheep that will produce the type of wool that is most acceptable to the market and will also protect the animal from the rigours of winter. In a wool improvement program, uniformity of fineness between different body areas (i.e., breech and shoulder) is an indication of good breeding, is also important as it eliminates extensive sorting before processing.

Staple length

Staple length is another fleece characteristic that is related to economic value since all wool within a particular grade must be of a certain length to obtain the highest price. Also, staple length is related directly to the amount of wool grown – that is, sheep with longer stapled wool will have heavier fleeces. Length of wool is a highly heritable characteristic and considerable improvement in fleece weights can be obtained by selecting for it. Uniformity of fibre length on the different body regions should also be considered because it reduces losses in combing processes and ultimately means a greater return to the grower.

Density of fibres

Selection on the basis of density (the number of fibres growing on a given skin area) is essential in a wool improvement program. **The greater the density, the greater the amount of wool produced.** Large differences exist between sheep in the same flock, and with experience it is possible to detect the superior sheep. This may be done by grasping the fleece at two or three points along the side and back and, based on the quantity of fleece held in the hand, judging which sheep produces the larger amounts of wool.

Final highlights for production of good fleece

Good fleece is not produced at the time of shearing but during the whole year. The following should be kept in mind:

- Breed for increased fleece weight, finer fibre and no coloured fibres. Breeding for a finer and heavier fleece gives Canadian wool a more competitive position on both domestic and world markets.
- Use proper health and nutritional practices. Consult an ag rep or sheep specialist for help and advice.
- Use approved feeders that allow sufficient feeder space for the flock and which protect the fleece.
- Handle all forage and bedding carefully to prevent it from entering the fleece. Immediately remove and dispose of baler and poly twines.
- Use sufficient clean bedding. Increased care in feeding and bedding translates into a cleaner more saleable product.
- Brand with a scourable marking substance. Paint makes fleece worthless as a marketable commodity.
- Practice proper weed control. Burrs and thistles will lower wool grade and market value.
- Crutch sheep before shearing, removing tags, burrs and chaff. More care in fleece preparation translates into better wool grades, more efficiency, a more valuable product and higher financial returns.
- Remove fleece in one piece and avoid second cuts.
- Never shear a damp sheep.
- Do not shear black face or leg fibres.
- Shear on a clean dry surface.
- Shear belly wool first and pack it separately.
- Shear dark sheep last and pack it separately.

Glossary of common wool terms

Apparel wool
Wool used in the manufacture of clothing, as opposed to carpet wool.

Blacks or black wool
Grey, brown or black fleeces, which are graded fine, medium and coarse. Their value is considerably lower than white fleeces.

Blood
The terms one-half blood, three-quarters blood, one-quarter blood and low one-quarter blood are American grades of wool indicating degree of fineness. Although the terms now have no relation to the breeding of the sheep from which the wool was shorn, originally they indicated the amount of Merino breeding present in the native sheep.

Braid
The coarsest of American wool grades, equivalent to coarse in the Canadian system.

Breech wool
Wool, usually the coarsest in the fleece, from the rear and lower parts of the hindquarters.

Bright wool
Subclass of wool.

Bucks or buck wool
Wool from rams. It has a characteristic odour and usually has a higher shrinkage than ewe wool.

Burry wool
Wool that contains burrs. Such wool has a high shrinkage, must be carbonized before it can be used, and as a result, is worth less than burr-free wool.

Carbonizing
A process by which burrs and other vegetable matter are removed from wool by chemical treatment (usually acids). Wool that requires this treatment is called “carbonized wool.”

Carding
A process to disentangle and separate the fibres from the matted lumps formed in scouring, to remove vegetable matter, to complete blending of different wools, and to produce a web of fibres of uniform thickness.

Carpet wool
A coarse wool used primarily in the manufacture of floor coverings but sometimes also used in coarse wearing apparel, e.g., Scottish Blackface wool.

Chaffy wool
Wool full of small particles of straw and hay.

Character
A term denoting a uniform and distinct crimp in wool fibres.

Clip
Refers either to the wool produced from one flock or to the total annual national or world production.

Clothing wool
Wool that is too short to be combed (less than 5 cm long), and hence is used in the manufacture of woolen and felt goods. This wool is not as valuable as combing or staple wool.

Coarse
The coarsest (36s-40s) of Canadian wool grades and equivalent to “braid” in the American system.

Combing wool
Wool at least 5 cm long that can be combed to remove the short fibres and to arrange the long fibres in parallel fashion.

Condition
Refers to the amount of grease and dirt in wool. Wool that is heavy in condition will have a high shrinkage when scoured.

Cotted fleeces or cotts
Fleeces in which the fibres have become matted or felted together while on the sheep. They occur more commonly in the coarser type wools than in the finer types. The condition may be caused by unfavourable weather conditions, sickness, or lack of yolk to protect the fibre.

Crimp
The natural waviness of the wool fibre.

Crutching
A process of removing the wool from the udder, breech and between the hind legs prior to lambing in order to improve the wool clip and reduce lamb losses. The wool removed is known as crutchings.

Dead wool
Wool removed from sheep that have been dead for some time. It is usually defective, has a strong odour, and sells at a lower price. Murrain wool, from decayed carcasses, is useless and of no value.

Defective wool
Wool that contains burrs or that has been sufficiently damaged by insects, disease, fire or water to lower its value after scouring.

Domestic wool
Wool produced on farms in contrast to that produced on range.

Down wool
Medium wool obtained from breeds of sheep originating in the downs of England.

Felting
The interlocking of wool fibres caused by the action of heat, moisture, chemicals and friction.

Fine wool
The finest grade of wool, normally obtained from the Merino or its sub-breeds.

Fleece
The wool from one sheep.

Frowsy, or mushy wool
Wool that is dry, weathered and wasty.

Grease
See “wool grease.”

Grease wool
See “raw wool.”

Kemp
A short, brittle, chalky white fibre found mixed in some fleeces. Kemp is a serious defect because it lacks strength and will not take dyes the same as wool.

Lanolin
Refined wool grease used in the cosmetic and lubricant industries.

Locks
Pieces of wool that become detached from the fleece in shearing or handling.

Longwool
Wool from certain British breeds (e.g., Lincoln, Leicester and Cotswold).

Medullation
Formation of empty spaces in the central portion of wool fibres.

Pelt
A wooled sheepskin.

Pulled wool
Wool that is removed from the skins of slaughtered sheep.

Raw wool
Wool as sheared from the animal, containing grease, salts and dirt. Also called “grease wool.”

Scouring
A process of removing dirt and grease from wool by means of a solution of soap and sodium carbonate.

Sebaceous gland
A wax gland at the root of each fibre.

Second cuts
Short pieces of wool produced by cutting the staple twice in shearing.

Semibright
Subclass of wool that lacks brightness because of the environment in which it grows. It has a higher shrinkage than bright wool but is just as white after scouring.

Shearling
English term for a yearling sheep after it has been shorn. Common method of naming age of sheep in Canada is one-shear, two-shear, three-shear and so on.

Shrinkage
The loss in weight due to scouring, expressed as a percentage.

Skirtings
The inferior and heavy shrinking portions of a fleece that are removed after it is shorn to improve the quality of the clip. Commonly practiced in Australia.

Spinning count
English system of wool grading based on the number of hanks of yarn obtained from 450 g of clean wool. One hank is 512 m long.

Stained wool
Wool that has been stained mainly by urine. As a result, it cannot be scoured completely white and is subject to a price discount.

Staple wool
Means the same as “combing wool” – minimum length of 5 cm. See “clothing wool.” Also refers to a bundle of wool fibres that cling together naturally in the fleece.

Strawy
Wool containing straw.

Suint
A hygroscopic mixture of the potassium salts of organic acids, such as oleic and stearic acids, and inorganic salts such as the carbonates, chlorides, phosphates and sulfates of calcium, sodium, potassium and magnesium. It is an excretion of sweat glands.

Tags
Heavy manure-covered locks of wool.

Tare
Weight of wool sacks deducted before settlement is made for the wool.

Tender wool
Wool that is weak and breaks easily. Tender wool is caused by either poor nutrition or sickness.

Virgin wool
Wool that is used in fabrics for the first time in contrast with wool that has been reclaimed from previously made materials.

Wasty wool
Wool that will lose much in manufacturing because it is weak, short or tangled.

Wool grease or fat
A greasy material, produced by the fat glands in the sheep's skin, that coats the wool fibres. "Wool grease" and "suint" combined are known as "yolk."

Woolens
Fabrics made from uncombed wool.

Worsteds
Any of various closely woven fabrics made from worsted yarns that were made from combed wool.

Yield
The percentage of clean wool after scouring: 100 minus shrinkage (percentage) equals yield (percentage).

Yolk
The natural secretions of sheep's skin, i.e., "suint" and "wool" grease combined.

Acknowledgments

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Sheep Producers, Ontario

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Mopani Communications Inc.

Conversion factors

Metric units	Approximate conversion factors	Results in
Linear		
millimetre (mm)	x 0.04	inch
centimetre (cm)	x 0.39	inch
metre (m)	x 3.28	feet
kilometre (km)	x 0.62	mile
Area		
square centimetre (cm^2)	x 0.15	square inch
square metre (m^2)	x 1.2	square yard
square kilometre (km^2)	x 0.39	square mile
hectare (ha)	x 2.5	acres
Volume		
cubic centimetre (cm^3)	x 0.06	cubic inch
cubic metre (m^3)	x 35.3 x 1.31	cubic feet cubic yard
Capacity		
litre (L)	x 0.035	cubic feet
hectolitre (hL)	x 22 x 2.5	gallons bushels
Weight		
gram (g)	x 0.04	ounces avdp
kilogram (kg)	x 2.2	pounds avdp
tonne (t)	x 1.1	short ton
Agricultural		
litres/hectare (L/ha)	x 0.089 x 0.357 x 0.71	gallons/acre quarts/acre pints/acre
millilitres/hectare (mL/ha)	x 0.014	fluid ounces/acre
tonnes/hectare (t/ha)	x 0.45	tons/acre
kilograms/hectare (kg/ha)	x 0.89	pounds/acre
grams/hectare (g/ha)	x 0.014	ounces avdp/acre
plants/hectare (plants/ha)	x 0.405	plants/acre

Canadian Co-operative Wool Growers Limited

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CSF•FCM
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Fédération Canadienne du Mouton

Canadian Sheep Federation

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